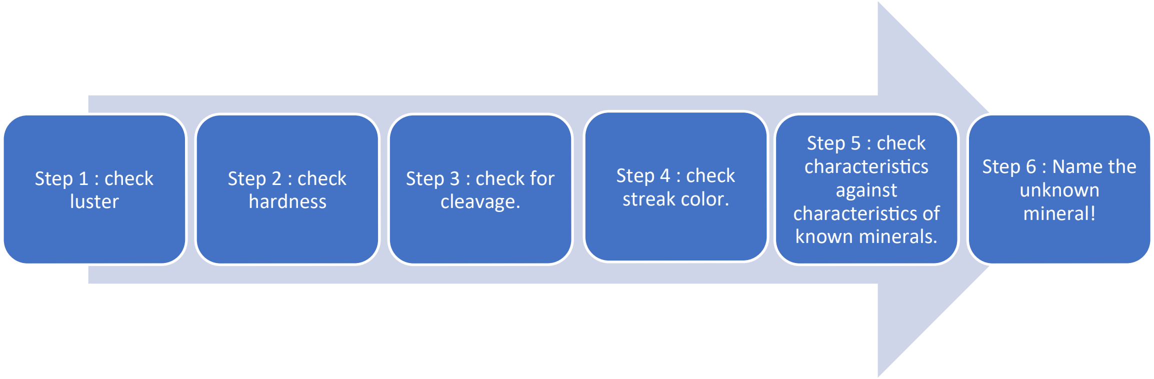
Ted Shapiro, Geology 120 Lab, Mineral Report; Due Tue, Sept 12

1. ***A mineral is naturally occurring, solid, formed by geologic processes, inorganic, has a crystalline structure, and a definable chemical composition.*** Naturally occurring means that it is not man-made, so a manmade diamond is not considered to be a mineral, even though it is virtually identical to a naturally occurring diamond. Solid means that it is not a liquid or a gas, (or a plasma), so lava cannot be a mineral because it is a liquid. Formed by geologic processes basically means not formed by biological processes as for instance amber or horn, but this definition has been modified to include some things such as shells of marine animals that form rocks, as for instance, limestone. Inorganic basically means not formed by biological processes also. So a natural diamond is considered to be a mineral, even though it contains carbon, because it is believed that the carbon was never in a living organism; while sugar crystals are not considered to be minerals because they were formed by living organisms using organic processes. A crystalline structure means that it has an orderly, predictable, atomic structure, as opposed to having the atoms randomly placed, like obsidian, which is therefore not considered to be a mineral. A definable chemical composition means that the elemental makeup is known, and can be represented using the elemental symbols.
2. ***The basic mineral properties include color, luster, crystal habit or form, cleavage, hardness, fluorescence, acid reaction, magnetism, radioactivity, and density.***
   Color relates to light reflected from the mineral in the visible range. Luster has to do with whether the mineral is shiny or dull, and if shiny, the type of shine, metallic or glass

-like (vitreous). Crystal habit relates to the shape of an unrestricted crystal, or of a cluster of unrestricted crystals. Cleavage is breaking in such a way as to expose straight lines and flat planes, and has to do with the underlying atomic structure of the mineral. Minerals tend to cleave where the bonds between atoms or molecules are weak, but some minerals, such as quartz, have very strong atomic bonds in all directions, and will not cleave. Hardness is the degree to which something resists scratching, and relates to the strength of the atomic bonds. A mineral's hardness is measured on the Mohs scale, a logarithmic scale from 1 (talc) to 10 (diamond).   Fluorescence relates to the specific color (wavelength) of visible light emitted by a given mineral when exposed to polarized light of a wavelength too short for the human eye to register. Acid reaction is the chemical reaction that carbonite minerals have to acid. Calcite ($CaCO_3$) will effervesce when exposed to acid. The acid knocks loose carbon and oxygen atoms which form CO_2 and escapes from the calcite as a gas. Magnetism is the attraction that certain minerals such as iron (Fe) have to a magnet, and relates to electron spin and alignment in the minerals. Some minerals such as uranium are radioactive, which means that they release high energy particles and or photons as they decay. These particles and rays can be harmful. Density is measured by dividing mass by volume: Density equals mass/volume. Some minerals such as lead or gold are very dense, while others such as talc or sulfur are less dense. The units of density are grams per cubic centimeter. Specific gravity is the density of the material divided by the density of water which is one gram per cubic centimeter, so specific gravity is simply the density of the material without units.

3. ***The general process of identifying a mineral***. A few minerals may be readily identified by color, but most cannot, so generally speaking, **step 1** in identifying an unknown mineral is to check the luster, and classify it as shiny or dull. If it is shiny, the luster is classified as either metallic or vitreous. If the luster is non-metallic, the mineral is classified as either light or dark in color. **Step 2** is to check the hardness by trying to scratch a glass plate. If it scratches the glass, which is 5.5 on the Mohs scale, the mineral is classified as hard, if it doesn't scratch the glass, it is classified as soft. **Step 3** is to check for cleavage. You can examine the existing piece for cleavage planes or hit it with a hammer and then check for cleavage. If there is cleavage visible, you categorize the cleavage by shape and number of sides. If the mineral is metallic, the next step is to check the color of the streak by rubbing the mineral across a streak plate, preferably unglazed porcelain. The color of the streak is recorded and compared against streak colors of known minerals. The next step is to compare the unknown mineral's characteristics to a list of characteristics of known minerals. The final step is to name the mineral.

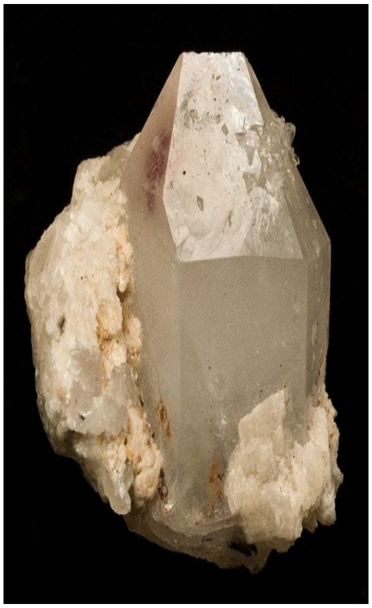
4. ***Flow chart***


Step 1 : check luster
Step 2 : check hardness
Step 3 : check for cleavage.
Step 4 : check streak color.
Step 5 : check characteristics against characteristics of known minerals.
Step 6 : Name the unknown mineral!

5. The Big Eight Minerals.

Quartz, kspar, plag, biotite, muscovite, amphibole, pyroxene, olivine.

Quartz



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Quartz (SiO_2) has a vitreous luster, and comes in many colors due to impurities, but a quartz crystal that has grown unobstructed is hexagonal (six sided), with an angle of 120^0 between adjacent sides. It is quite hard, 7 on the Mohs scale. Due to its very strong molecular structure it does not cleave, rather, it fractures conchoidally or randomly.

K-spar, orthoclase, or potassium feldspar ($KAlSi_3O_8$) has a non-metallic luster and can be orange, brown, white, green, or pink. The streak is white. It forms translucent prisms with sub parallel lamellae. (hair like lines running in approximately the same direction). The cleavage is excellent in two directions at 90^0. It is fairly hard, (6 on the Mohs scale.) its specific gravity is 2.5 -2.6.

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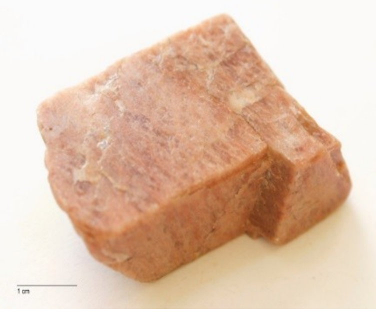

K-spar.

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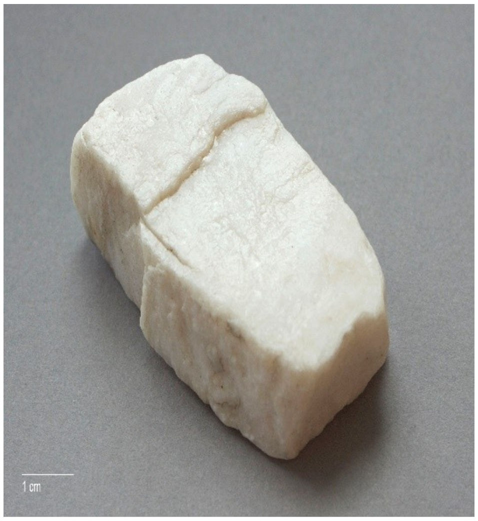
Plag, or Plagioclase feldspar has a non-metallic luster, and can be colorless, white, grey, or black. The streak is white. It is moderately hard, 6 on the Mohs scale. It forms striated tabular or blade like crystals. It cleaves well in two directions at 86^0 and 94^0. It often exhibits parallel hairline striations. SG = 2.6-2.8



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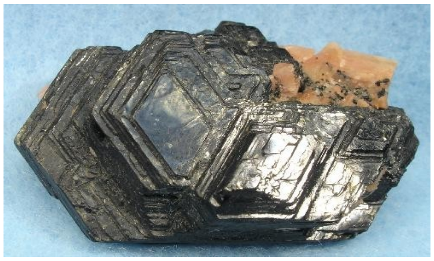

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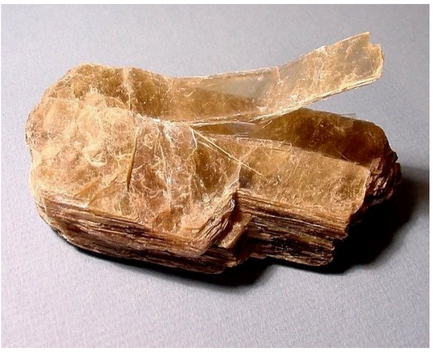
Biotite mica, (ferromagnesian potassium hydrous aluminum silicate) has a vitreous luster, and can be black, green black, or brown black. The streak is grey-brown to white. It forms very short prisms. The cleavage is excellent and it easily splits into very thin flexible sheets. It is fairly soft, 2.5 to 3 on the Mohs scale. The specific gravity is 2.7-3.1



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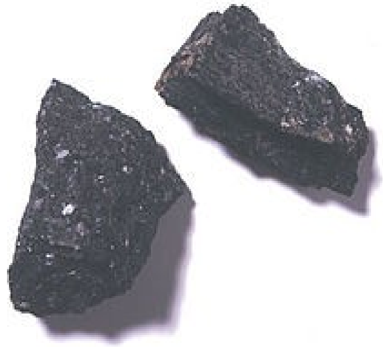
Muscovite Mica, (potassium hydrous aluminum silicate) has a vitreous luster, and can be colorless, yellow, brown, or reddish brown. The streak is white. It is soft, about 2-2.5 on the Mohs scale. It forms short opaque prisms. The cleavage is excellent in one direction, and it can be split into thin flexible transparent sheets. SG = 2.7 – 3.

Hornblende, an Amphibole, has a non-metallic luster, and a monoclinic crystal structure. It can be from dark grey to black in color. The streak is white to pale grey. It is medium hard, 5.5 – 6 on the Mohs scale. It forms prisms, and has good cleavage at angles of 56^0 and 124^0. It is brittle and splintery or stringy. SG = 3 – 3.3



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Pyroxene, also known as augite, is a calcium ferromagnesian silicate, and has a non-metallic luster, and a monoclinic crystal structure. The color ranges from dark green to brown or black. The streak is white to pale grey. It is medium hard at 5.5 to 6 on the Mohs scale. It forms short, 8 sided prisms. It has two good cleavages that intersect at 87 and 93 degrees. The specific gravity is 3.2 – 3.5.

Olivine, $(Fe, Mg)_2SiO_4$ is a ferromagnesian silicate. The color can range from pale or dark olive - green to yellow, or brown. It has a non-metallic luster. It is quite hard at 7 on the Mohs scale. The crystal structure is orthorhombic. It forms short crystals that may resemble sand grains. There is no cleavage. It is brittle and fractures conchoidally.

SG = 3.3 to 3.4

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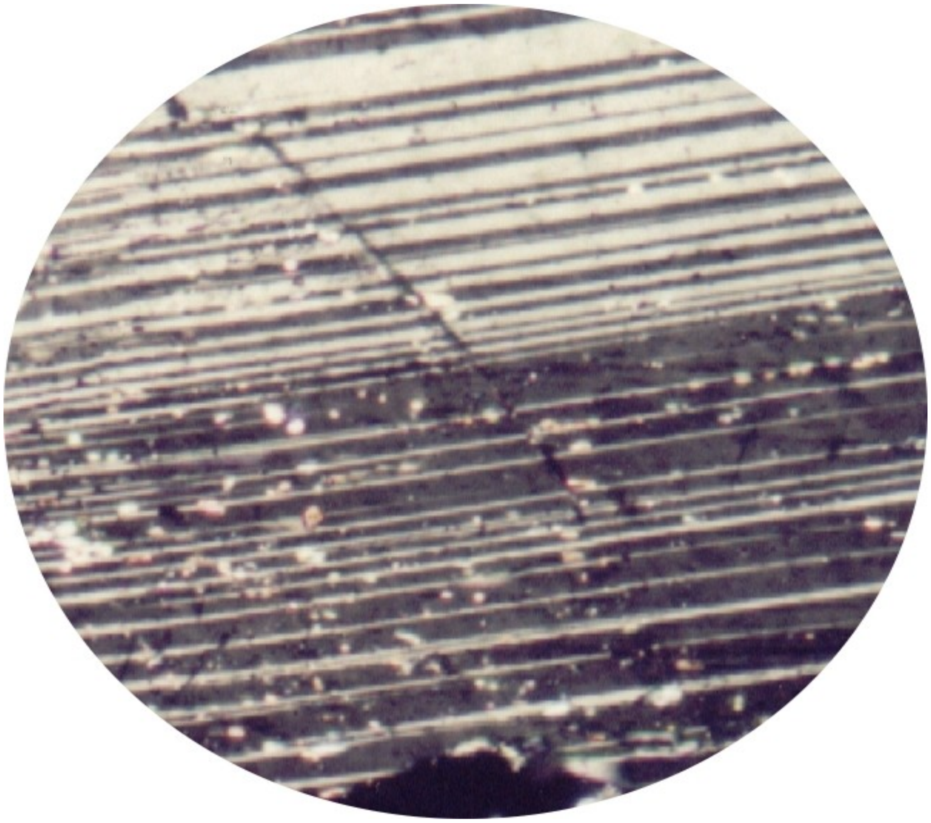
6. Thin Section image. **Plagioclase.**



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